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A Comparative Analysis of Information Communication Technologies Development: A Study of Azerbaijan and Balkan Countries

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Abstract: Development of information and communication technologies (ICTs) plays a pivotal role in promoting overall technological progress in a nation and enabling transformative changes in various sectors. By providing a solid foundation for digital infrastructure, ICTs facilitate innovation, increase productivity, and spur economic growth, placing a nation at the forefront of the global technological landscape. The main objective of this study is to compare Azerbaijan's ICTs development with that of Balkan countries. The growing cooperation between Azerbaijan and the Balkan countries is primarily focused on the energy sector, but there is limited understanding of the technological similarities and differences. To further enhance this cooperation, a comprehensive study of the technological infrastructure and the identification of areas of convergence and divergence are essential. This study will facilitate informed decision-making, pave the way for expanded cooperation in various sectors beyond the energy sector, and promote mutually beneficial relations between Azerbaijan and the Balkan countries. The results of this study, based on hierarchical cluster analysis (HCA), show that Azerbaijan is similar to Balkan countries such as Albania, North Macedonia, and Bosnia and Herzegovina when calculating the average values (between the years 2010 and 2020) for various ICTs variables (e.g., 4G coverage, Internet users). The HCA of recent years, like 2020, shows the same picture. This means that there are some similar patterns of ICTs usage and investment in these countries. At the same time, an oil-rich country like Azerbaijan could be comparable to the leading Balkan countries like Greece, Romania, Slovenia, etc. While this gives the Azerbaijani government food for thought, the findings also highlight the potential for cooperation and knowledge sharing between Azerbaijan and the Balkan countries in the field of ICTs, as they can learn from each other's experiences and work together to further improve their respective ICTs sectors.

Keywords: *Azerbaijani economy; Balkan countries; hierarchical cluster analysis; information communication technologies; technological change.*

1. Introduction

Technological change encompasses the dynamic process of conceptualizing, creating, and disseminating novel technologies or processes, serving as a cornerstone for driving advancement and fostering development across multifaceted domains, including but not limited to health, agriculture, energy, and global socio-economic progress [1]. Technological change is currently reshaping the global economy at an unprecedented pace, driven by transformative innovations in fields such as artificial intelligence, blockchain, and renewable energy. This rapid evolution is disrupting traditional industries, creating new market opportunities, and fostering productivity growth and [2, 3]. Furthermore, the ongoing digitalization and connectivity revolution, coupled with advancements in automation and robotics, are fundamentally transforming the nature of work and labor markets [4, 5].

Technological change plays an increasingly significant role in shaping the economies of small countries, driving innovation, and fostering economic growth. As small countries often face resource constraints and limited market size, harnessing technology becomes crucial for their competitiveness and development. The adoption and integration of advanced technologies enable small countries to overcome geographical limitations, enhance productivity, and participate in global value chains [6]. Additionally, technology-driven sectors such as ICTs have the potential to drive economic diversification and attract foreign direct investment (FDI) in small economies [7]. Therefore, small countries that embrace technological change can create favorable environments for entrepreneurship, boost their digital infrastructure, and leverage digital platforms to enhance International trade and

connectivity [8]. Therefore, recognizing the increasing importance of technological change and formulating appropriate policies to support innovation and technology adoption are crucial to catch up with the advanced economies.

The main objective of this paper is a descriptive comparison and non-parametric evaluation of the Balkan countries and the Republic of Azerbaijan from the point of view of technological change and development. ICTs were chosen as the main channels of this technological change, as it is the main driver of ongoing development. The main reason for this analysis is the fact that in recent years, cooperation between several Balkan countries (e.g., Bulgaria, Greece, and Romania) and Azerbaijan has increased in the field of energy and related areas [9–11]. This is also reflected in integration in the cultural and social spheres, as well as in public services and tourism [12]. Geographically and culturally, the Balkan region and the South Caucasus are close to each other. These regions also had similarities in their recent past, i.e., ethnic conflicts and socialist state-building, which made these countries institutionally comparable. Some studies have tried to evaluate the relations between the Balkan countries and Azerbaijan, but their main focus has been on International relations, politics, etc. [13–15]. There is no English-language publication that has examined the technological similarities between these countries. Therefore, the research questions of this paper are as follows: How has technological change occurred in the Balkans and Azerbaijan in recent decades? With which specific Balkan countries is Azerbaijan comparable in the adoption of ICTs? Therefore, the main purpose of this study is to shed light on the technological similarities and differences between the Balkan region and Azerbaijan through ICTs. To achieve this goal and answer the research question, this study uses descriptive and hierarchical cluster analysis (HCA) of the selected indicators (e.g., Internet users, 4G coverage). This work contributes to the literature by providing precisely derived, non-parametric empirical results that provide an outlook on future cooperation and integration between Azerbaijan and the Balkan countries.

Thus, the second section provides country-based ICTs-related works and studies that describe and introduce each country to the readers in a brief way. The third section reports on the data and methodology of the study. The fourth section presents the results, while the fifth section is devoted to discussion of the empirical findings. The sixth and final section provides concluding remarks.

2. Literature Review

This section of the literature review focuses on the development of ICTs in each Balkan country and notable events, also highlighting key facts and trends in Azerbaijan. The main objective of this literature review is to provide a concise overview of the case countries that allows the reader to understand the empirical and nonparametric results in a contextual framework.

When considering the role of ICTs in the overall global technological changes of nations, it is important to understand their transformative impact. ICTs have revolutionized various sectors, including communication, business, education, healthcare, and governance [16]. They enable the efficient transfer of information, foster innovation and productivity, and facilitate connectivity on a global scale. Currently, ICTs also play a critical role in sustainable development by facilitating environmental monitoring, resource management, and the transition to clean energy [17]. To understand the role of ICTs in global technological change, one must recognize their transformative power, their potential for economic and social development, and the need for inclusive and sustainable use. ICTs can help nations meet the challenges and opportunities of the digital age and contribute to their overall progress. Therefore, each Balkan country and Azerbaijan should be assessed separately and briefly before considering an empirical study.

Let us start with Croatia: the ICTs sector is experiencing growth, although it still faces challenges related to connectivity and the digital economy. In the Digital Economy and Society Index (DESI) 2020, Croatia ranks 20th among the 28 EU member states [18]. The country has a high internet usage rate of 77% in its population and the highest percentage of people aged 16–24 with basic or more than basic digital skills in the EU. Although Croatia's use of cloud technologies is above average, the country lags behind other EU countries in electronic information exchange. The Croatian government has identified

four digital priority areas: digital transformation of the economy, digitization of government and the judiciary, development of broadband communication networks, and promotion of digital skills and employment [19]. Thus, after eliminating some minor age and gender gaps in ICTs in Croatia, it can be said that the country might fully reap the benefits of the most modern technological shifts in Balkan region [20].

Slovenia has an advanced ICTs infrastructure, including a 5G network and extensive high-speed broadband coverage, making it one of the leading countries in the region [21]. The country's ICTs sector includes companies involved in the production and provision of ICTs. Various studies have been conducted to analyze the impact of ICTs on financial and management tools [22]. To guide its strategic development in ICT, Slovenia has introduced the Strategy for the Development of the Information Society until 2020—Digital Slovenia 2020—which outlines the main objectives. This strategy includes initiatives such as the Next-Generation Broadband Network and the Next-Generation Access Project, which aim to provide broadband access to all households and businesses in the country. In order to achieve its strategic development goals in ICTs, the government of the Republic of Slovenia has adopted this strategy. Important organizations such as the Ministry for Digital Transformation, the Agency for Communications Networks and Services of the Republic of Slovenia, and the ICTs Technology Network Institute are actively involved in supporting and promoting ICTs development [23].

Another Balkan country that seems to have a noteworthy ICTs sector is Greece. Indeed, Greece has positioned itself as a hub for ICTs firms, attracting both domestic and International companies looking to set up shop in Southeastern Europe [24]. ICTs helped Greece achieve higher levels of productivity, but in the early 2000s, low efficiency in human capital development reduced the overall contribution of ICTs to the economy [25]. Nevertheless, ICTs have become more important in Greece due to the increasing demand for automation and digital transformation [24]. Moreover, the use of ICTs has significantly changed the travel industry, especially through e-tourism, which is revolutionizing tourism procedures and services [26]. As the ICTs market in Greece shows growth and will reach a value of \$7.203 billion in 2021, the country's favorable geostrategic location increases its potential to become a central hub for ICT companies in Southeastern Europe [27, 28].

Bulgaria faces numerous challenges in the area of ICTs, which have been exacerbated by the economic difficulties of recent years. These challenges are evident in the education and health sectors, where ICTs and institutional problems persist, resulting in limited technological literacy and a suboptimal ability to adopt technological advances. Kilova et al. emphasize Bulgaria's lag in ICTs implementation, particularly in telemedicine, while Paunova-Hubenova and Trichkova-Kashamova highlight the uneven distribution of ICTs in vocational training institutions, despite some positive trends in overall ICTs use in the country [29, 30]. In addition, Vodenicharova points out that ICTs in supply chains are inadequate, which hinders efficient and competitive business dynamics in Bulgaria [31].

Albania is also trying to bolster ICTs. After analyzing the ICTs-centric innovation ecosystem in Albania, researchers concluded that the ecosystem's behaviors, knowledge, resources, and networks naturally become more robust over time as success stories inspire and attract additional resources and attention [32]. The research findings of Gjika and Pano highlight the important role of digital technologies in Albanian tourism, with tour operators showing higher levels of ICTs use than the average of economic activities in the country [33]. This means that while there are initial elements of "smart tourism," such as personalized communication and digital marketing, tour operators still have room for improvement in adopting Tourism 4.0 technologies and technology-based business models, although their knowledge and awareness of the benefits of technology should drive progress in this direction.

The other Balkan countries, such as Bosnia and Herzegovina and Montenegro, are also examined in the context of problems and trends in their ICTs. It seems that tourism and cultural events are the main drivers of ICTs in the Balkan countries, as the Museum of Bosnian Traditional Objects, the Stecaks Digital Catalog, and the Sarajevo Assassination Virtual Museum are among the virtual museums developed by researchers in Bosnia and Herzegovina [34]. Various 3D digitization techniques were

used to create these immersive environments [34]. To accelerate the development of ICTs, citizens must have a foundation in communication sciences and develop media literacy in ICTs. However, the idea of media and ICTs education is not firmly established in either the public or academic communities in Bosnia and Herzegovina, making it a lengthy and difficult process to incorporate into educational programs.

Montenegro's efforts in ICTs, especially after the COVID-19 pandemic. The ICTs industry in Montenegro responded quickly to the call for new electronic services, which were essential for teleworking, online education, and online business during the COVID-19 epidemic. The Government Plan 2021 identifies digital transformation as one of six guiding principles [35]. In addition, the latest thinking on ICTs, such as cooperative intelligent transportation systems, is assessed by researchers [36].

Serbia's ICTs sector has experienced significant growth and development in recent years, bringing both opportunities and challenges to the country's technological landscape. For example, in May 2023, a Memorandum of Understanding was signed between Serbia and Qatar on cooperation in the field of information and communication [37]. Moreover, since the early 2000s, the modernization of agriculture in Serbia has depended heavily on the effective diffusion and adoption of innovations, knowledge, and technologies [38]. However, the recent transformation of the traditional business sector into a more efficient and digital business sector is progressing very rapidly and remarkably [39].

Based on the report of the International Trade Administration, the following can be said for Romania: the ICTs sector in Romania is strong and has a significant number of highly qualified professionals in the ICTs industry [40]. Romania's GDP is expected to have recovered "almost to pre-crisis levels" by the first quarter of 2021, mainly thanks to the contributions of this sector. In terms of telecom networks and internet speeds, Romania ranks sixth among the fastest-growing countries for fixed broadband and forty-third for mobile internet. With the introduction of 5G services, Romania has risen to second place overall and holds the top spot for download speeds. Thanks to the superior quality of its electronic communications systems, companies in Romania have been able to switch to remote working seamlessly and without major setbacks.

The ICTs market in North Macedonia reached a value of about \$1 billion in 2021, with software and IT services accounting for 56% of the total value [41]. The thriving ICTs industry in North Macedonia can be attributed to several factors, including the presence of a highly skilled and cost-effective workforce, an advanced telecommunications infrastructure, and continued government and private sector investment in the sector [42]. To gain a competitive advantage, small and medium-sized enterprises (SMEs) in North Macedonia are increasingly relying on big data analytics and artificial intelligence algorithms [43]. The telecommunications sector in North Macedonia is focusing on customer experience and touchpoint management, as these have a significant impact on customer loyalty [44]. Investments in digital technology, infrastructure, and operational processes will improve the global competitiveness of the Macedonian economy, and the acceleration of digital transformation in North Macedonia was catalyzed by the COVID-19 pandemic [45].

Finally, the ICTs sector is a crucial sector for economic diversification in Azerbaijan and the second most important target for foreign capital investment after the oil and gas industry. Azerbaijan ranks 56th out of 144 countries on the World Economic Forum's "Networked Readiness Index" in its "Global Information Technologies 2013" report. Azerbaijan has made great strides in developing its ICTs sector [46]. The government has successfully implemented various e-governance projects to improve education and expand access to online resources. Initiatives such as the introduction of electronic application and payment services by the Customs Committee and the launch of the "mobile digital signature system "Asan Imza" by the Ministry of Taxes demonstrate Azerbaijan's commitment to digital transformation [46]. The country has also expanded its satellite services as part of its efforts to strengthen its local commercial telecommunications infrastructure. In addition, organizations in Azerbaijan, such as the Information Communication Technologies Applying and Training Center LLC, are engaged in education and training related to the information society, e-government, and e-communications [47]. The Information and Communication Technologies Agency, a public legal entity, oversees the development of the ICTs sector in Azerbaijan [47].

Although Azerbaijan has achieved numerous successes in ICTs development (which has also been called a technological leapfrogging [48]), the country still faces several challenges. One of them is the monopolistic structure of the telecommunications sector, which causes high costs for the provision of services [49]. According to the Asian Development Bank's assessment, Azerbaijan is still not exploiting the full capacity of ICTs to achieve the optimal level of transformational power that modern technologies can provide for productivity growth and wealth creation [50]. This invites a closer analysis of Azerbaijan's position and capacities, especially in a comparative manner.

3. Data and Methodology

This work focuses on the ICTs development of Balkan countries and Azerbaijan in a comparative way. For this reason, this study can be considered a comparative economics study. Comparative economics is a field of study that aims to compare and analyze different economic systems and policies between countries or regions [51]. The main methodology of comparative economics involves a combination of theoretical frameworks, empirical analysis, and interdisciplinary approaches to shed light on the complexity of different economic systems and their implications. Similar to Asongu et al. [52], this paper provides a comparative analysis of ICTs and draws some relevant conclusions. For this purpose, OurWorldInData.org was selected as the data source for this study, and numerical analysis and HCA were the main research methods.

HCA is a statistical method used to group similar objects or individuals into clusters based on their similarities or dissimilarities [53, 54]. It involves creating a hierarchical structure of clusters, where objects or individuals that are more similar to each other are grouped together at lower levels, and those that are less similar are grouped at higher levels [54]. This method helps to uncover patterns and relationships within a dataset, allowing for the identification of distinct groups or clusters [53]. Hierarchical cluster analysis is widely used in various fields, including data mining, biology, social sciences, and market research, to explore data and gain insights from complex datasets [55].

This study followed the guidelines of Sarstedt and Mooi for performing a typical HCA [56]. The current HCA in this research was performed in two stages: HCA of the averaged values of the variables of interest for the period 2012–2020 and HCA of the values for 2020. This approach helps to identify shifts in commonalities and differences across case countries and provides a sense of the dynamics. Additionally, HCA was based on Ward's Linkage (or Method) as a clustering method that was applied to the unstandardized variables, employing squared Euclidian distance as an interval measure. Ward's method provides more interpretable clustering solutions [56]. Clusters were visualized using dendrograms.

The data period was between 2012 and 2020 for variables such as fixed telephone subscriptions (per 100 persons), fixed broadband subscriptions (per 100 persons), mobile subscriptions (per 100 persons), Internet users (in % of population), and 4G network coverage (in %). The country pool included Croatia, Azerbaijan, Slovenia, Greece, Bulgaria, northern Macedonia, Serbia, Romania, Bosnia and Herzegovina, Montenegro, and Albania. The dataset was available in annual form and had very few missing values. Only Albania was missing the time series variable needed to measure 4G network coverage. Therefore, the missing value was replaced by the overall average of the Balkan region in the first stage of the cluster analysis. In the second stage of the cluster analysis, the value for 2020 from the United Nations Economic Commission for Europe dataset was used in the case of Albania.

SPSS version 23 was used to estimate the results.

4. Results

4.1. Figure Analysis

Figure 1 shows that most Balkan countries have less than 5 million inhabitants (e.g., Croatia, Slovenia, Montenegro), while Serbia and Bulgaria have 6–7 million inhabitants, according to data from recent years. Although Romania has experienced a population decline since 1990, it was the largest Balkan country with 19.33 million inhabitants in 2021. Azerbaijan and Greece, meanwhile, have similar

population dynamics: 10.31 and 10.45 million people in 2021, respectively. In general, Azerbaijan is more populous than most Balkan countries and has a growing and rapid trend. In most Balkan countries, population growth has been either stable or declining, especially since the early 1990s.

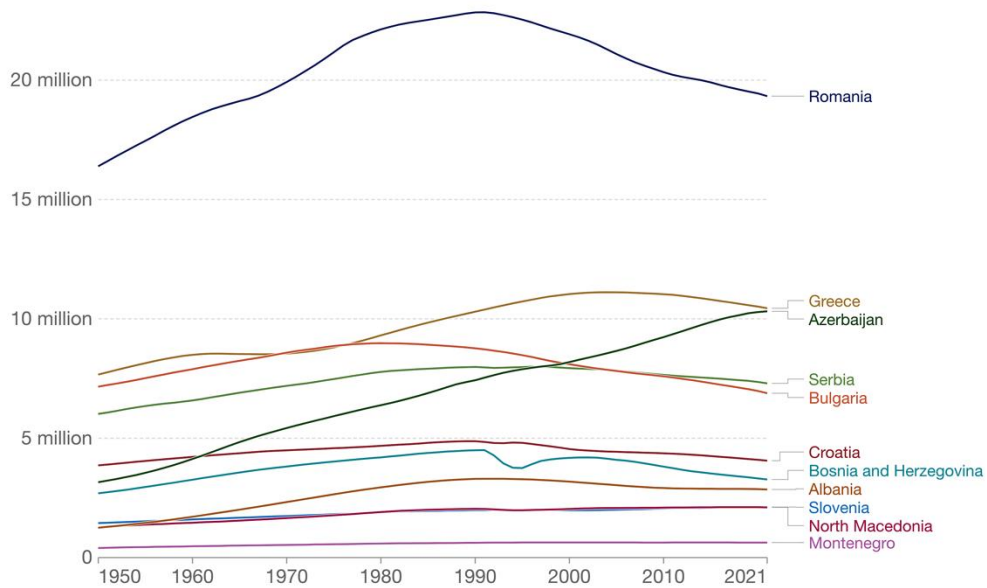


Figure 1. Total population data of the case countries, in million people, 1950–2021.

Source: OurWorldInData.org/world-population-growth

In terms of gross domestic product (GDP; current prices), Azerbaijan is comparable to most Balkan countries, i.e., it is similar to Bulgaria, Slovenia, Croatia, and Serbia (see Figure 2). However, Romania and Greece have higher GDPs, approaching \$200 billion. Bosnia and Herzegovina, Albania, and Northern Macedonia have GDPs of less than \$20 billion. On average, Azerbaijan has an economic capacity comparable to the average of the Balkan countries, which creates the necessary analytical conditions for conducting a comparative analysis between the two regions.

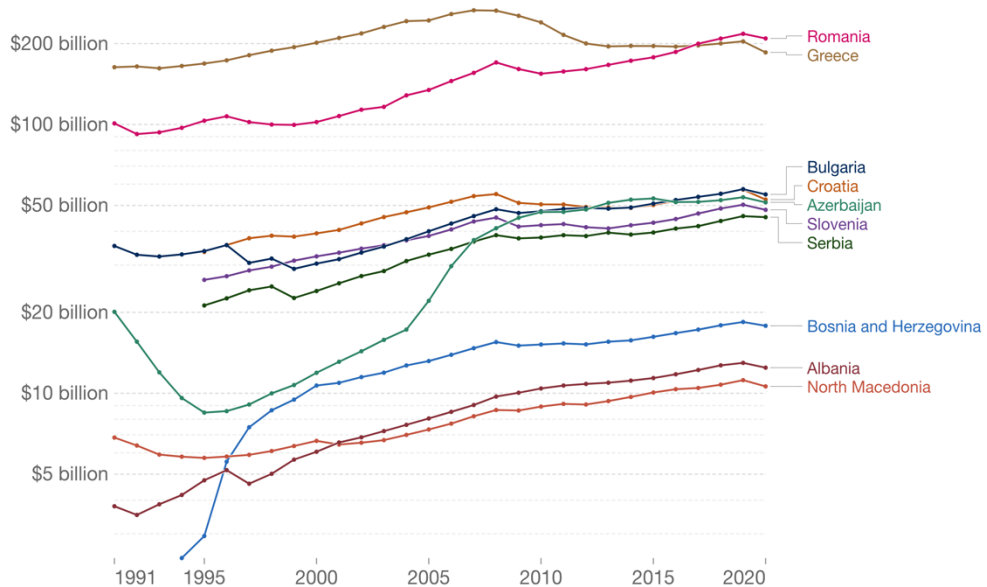


Figure 2. Gross Domestic Product (GDP) data of the case countries, in billion USD, 1991–2020.

Source: OurWorldInData.org/economic-growth

Prior to the HCA, some selected Balkan countries and Azerbaijan were compared with ICTs variables. Figure 3 illustrates the results. For example, the population's access to 4G networks in Azerbaijan is low and has been lower than in other Balkan countries since 2012 (Figure 3, panel a). The

number of Internet users in Azerbaijan has been significantly higher than in the other countries since 2010 and has shown rapid growth rates (Figure 3, panel b). While the number of mobile subscriptions in Azerbaijan has increased in recent years (Figure 3, panel c), the number of landline Internet subscriptions per 100 inhabitants has declined significantly since 2015 (Figure 3, panel d). This is a descriptive look at possible similarities and differences between the Balkan countries and Azerbaijan. Therefore, an appropriate and more systematic type of analysis would be HCA.

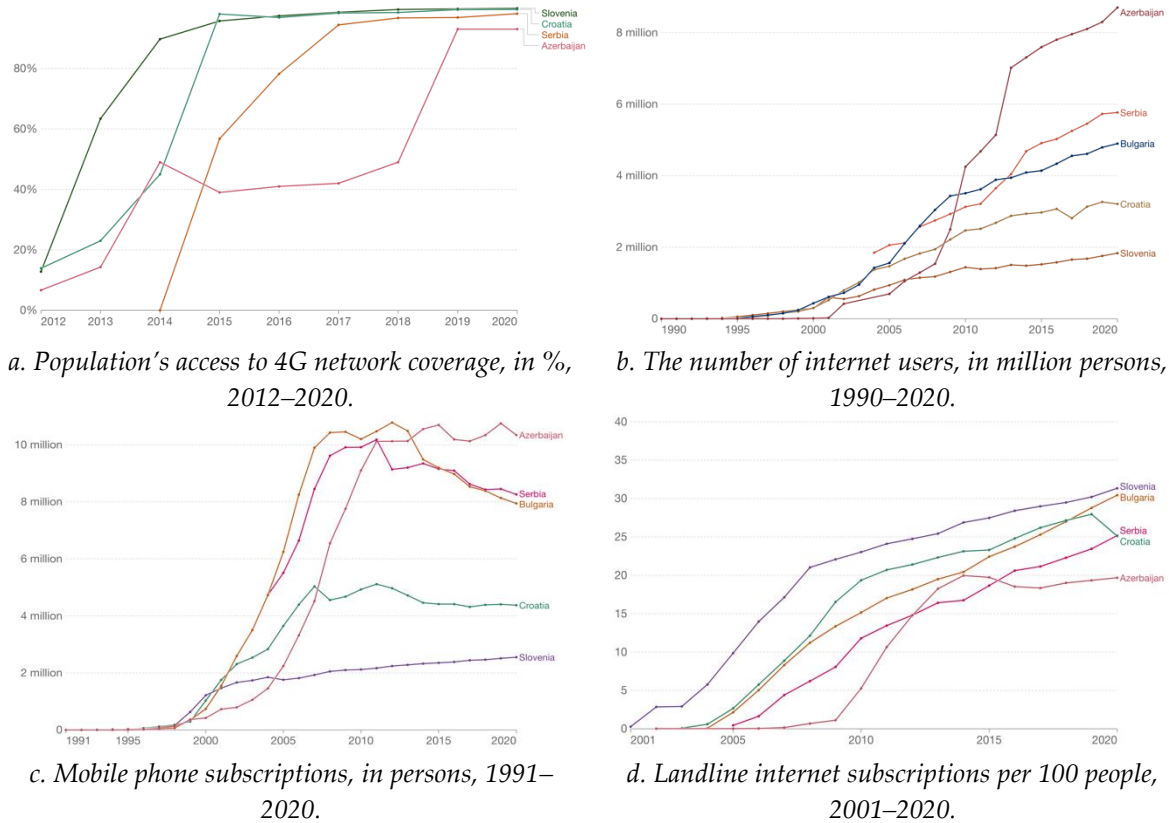


Figure 3. Mobile network and Internet statistics for the selected Balkan countries and Azerbaijan.
Source: OurWorldInData.org/internet; OurWorldInData.org/technological-change;

4.2. HCA Results

The HCA conducted with the average values between 2012 and 2020 resulted in the formation of three interpretable clusters (see Figure 4). Cluster 1 consists of Croatia, Slovenia, and Greece, while cluster 2 includes Bulgaria, Romania, and Serbia. Bulgaria and Romania are more directly related to each other, while Serbia converges with them at the second level. A smaller cluster, cluster 3, includes North Macedonia and Bosnia and Herzegovina, which are closely associated with Albania and Azerbaijan, both of which form separate clusters. Since the primary purpose of this study is to position Azerbaijan in a comparative manner with the Balkan countries, the first HCA shows similarities between Azerbaijan and Albania, North Macedonia, and Bosnia and Herzegovina. These countries exhibit lower values for their ICTs variables of interest compared to clusters 1 and 2 (see Figure 4).

Figure 5 shows the results of the second HCA, which has a similar pattern to the first HCA with some minor differences. This second HCA focuses on the 2020 values, and it is evident that Azerbaijan again shows similarities with Albania and North Macedonia, forming cluster 2. This cluster shows a higher degree of convergence compared to the first HCA based on average values. It is worth noting that Albania has the lowest values for most ICTs variables in the Balkan region in 2020, while North Macedonia performs comparatively better than Azerbaijan and Albania. Despite these differences, they still belong to the same cluster, indicating common characteristics and trends.

Clusters 1 and 3 in Figure 5 reveal more dispersed and smaller clusters. In cluster 1, Bosnia and Herzegovina, Bulgaria, and Romania exhibit similarities among themselves. Additionally, these

countries display slightly lower ICTs values compared to cluster 3. Conversely, cluster 3 comprises Slovenia, Serbia, Croatia, and Greece, which share similarities with each other. Notably, this cluster demonstrated the highest ICTs values among the Balkan region in 2020.

In both HCAs, Montenegro stood alone as a separate cluster. Although certain ICTs in this country surpass the Balkan average, others lag behind. Being an outlier case, it is expected for Montenegro to be excluded from the main cluster formation in the HCA procedure. Hence, there is no need for a meaningful interpretation of Montenegro's relative position in this HCA.

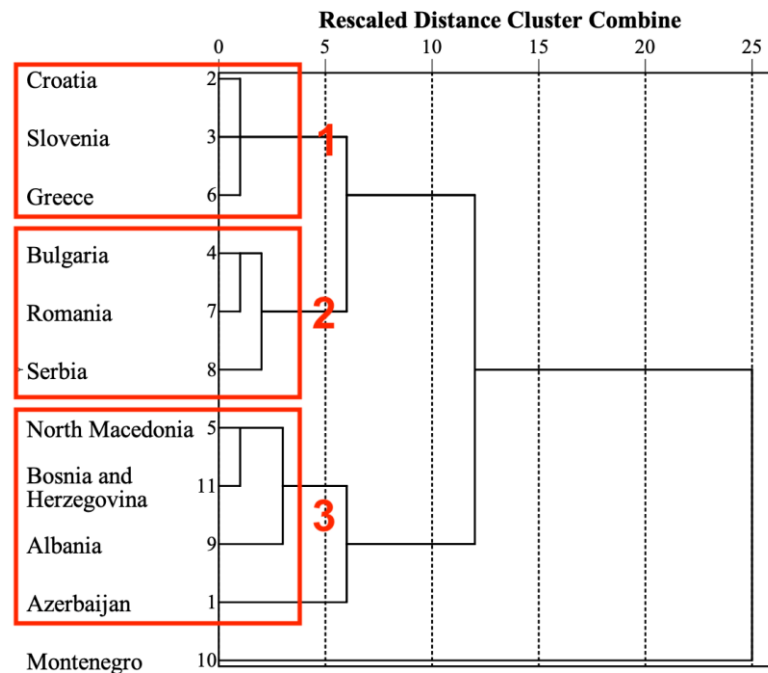


Figure 4. Hierarchical cluster analysis of the information communication variables based on the average values of the period between 2012 and 2020.

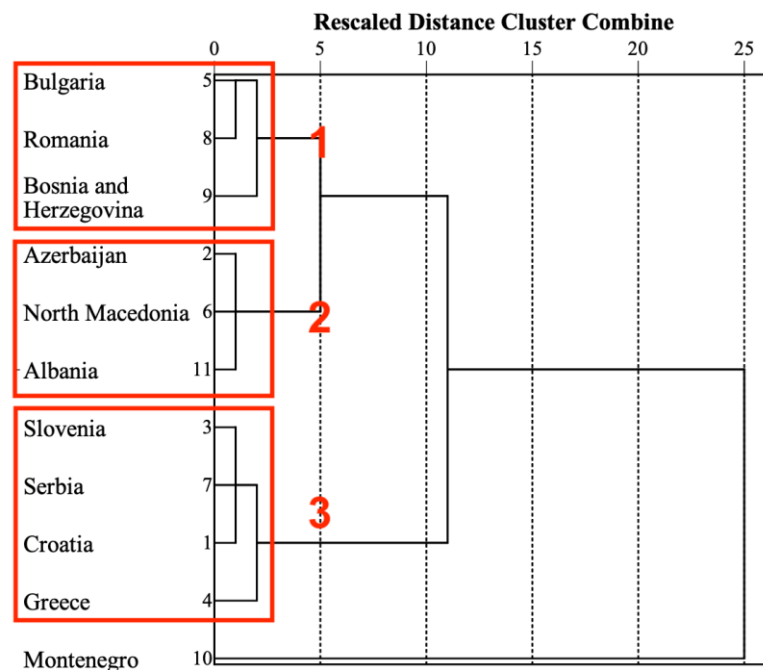


Figure 5. Hierarchical cluster analysis of the information communication variables of 2020.

5. Discussion

In terms of population, Azerbaijan shows promise with an increasing and positive trend in its overall population growth. However, many countries in the Balkan region exhibit stable or even downward trends in their population growth dynamics. While population can serve as a measure for market size, factors such as overall welfare and economic possibilities provide another perspective on the topic. Taking GDP values (in current USD) into account, Azerbaijan demonstrates comparability with a significant number of Balkan countries and in some cases surpasses countries like Albania, North Macedonia, and Bosnia and Herzegovina. This is an indication of the country's economic potential to increase the ICTs adoption rate and experience rapid technological change. However, this study has shown that Azerbaijan still has many challenges to overcome because the country can only be compared with the Balkan countries that need to develop their ICTs sector (Albania, North Macedonia, Bosnia and Herzegovina), not with the potentially successful benchmark examples (Romania, Greece, Slovenia, etc.). This is an interesting aspect of the Azerbaijani economy that should be studied comparatively and systematically, as is done for the first time in this study.

The overall economic outlook for Azerbaijan is positive and promising, especially since the outbreak of war between Russia and Ukraine in 2022. As a country rich in oil and gas resources, Azerbaijan intends to meet significant demand for natural resources in European markets in the coming years. In addition, there are ongoing reforms and economic policies aimed at diversifying the economy, increasing total factor productivity, and utilizing idle production capacity. These factors can contribute to the rapid development of ICTs in Azerbaijan. In general, however, Azerbaijan has lower ICTs values than the Balkan region, where there is also a significant difference among the countries.

The finding that Azerbaijan is more similar to Albania, Bosnia and Herzegovina, and North Macedonia is rather surprising, considering that Azerbaijan is developing rapidly and has accumulated great oil wealth that could be used to introduce technologies and ICTs. However, the HCA results of this study clearly show that Azerbaijan and some countries in the Balkan region have lower but similar values for lagging ICTs development and technology adoption. The reasons for this give rise to an interesting discussion. There could be several reasons.

First, these countries may face similar challenges in terms of infrastructure development, funding, and regulatory frameworks. Limited financial and human resources could prevent them from investing in and adopting new technologies at the same pace as their neighbors. Second, historical and socioeconomic factors could also play a role. These countries might have experienced similar historical events or transitions, such as political changes, wars, or economic restructuring, which could have influenced their technological development. In addition, the availability of technological expertise and access to educational resources could influence the rate of technology adoption. If these countries face the same challenges in terms of education and skill development, this could contribute to their slower ICTs.

This topic has not yet been addressed in a comparative way. Limited funding may be available for ICTs research, which may affect the amount and scope of scholarly work in these regions. Academic institutions and researchers may prioritize other areas of study over ICTs. This could be influenced by factors such as national priorities, research trends, or the availability of expertise in certain areas. If researchers in Azerbaijan and the Balkan countries collaborate in the field of ICTs, this may solve the scarcity of research. However, a comparative analysis allows the identification of similarities and common patterns between different countries. By analyzing ICTs developments in both the Balkans and Azerbaijan, common challenges, trends, and opportunities in the region can be identified. In addition, comparative analysis offers countries the opportunity to benchmark their performance and learn from each other's experiences. By examining the ICTs and strategies of the Balkan countries and Azerbaijan, policymakers and stakeholders can gain insights and ideas for improving their own ICTs sectors. Therefore, this type of work can improve our understanding of technological change.

It is also interesting to note that despite extensive state funding and ICTs, Azerbaijan continues to lag behind some Balkan countries in this area. This invites analysis of the effectiveness of government funding and support initiatives, which may be influenced by various factors such as implementation strategies, coordination among relevant actors, and government practices. Even with large-scale

investments, inadequate planning, inefficient resource allocation, or limited accountability mechanisms could hinder desired outcomes. Moreover, developing a robust ICTs ecosystem requires a comprehensive and multi-faceted approach. This includes not only financial investment but also the presence of skilled human resources, a supportive legal and regulatory framework, advanced infrastructure, and a culture of innovation and entrepreneurship. Inconsistencies in any one of these areas could hinder the overall progress of ICTs development.

The digital divide, which includes inequalities in access to ICTs infrastructure and digital skills, could be a contributing factor to low ICTs development. Unequal distribution of resources and limited access to technologies in certain regions or population groups may hinder the widespread adoption and use of ICTs in Azerbaijan. Therefore, appropriate policies and reforms must be considered to accelerate technology adoption and transformation.

6. Concluding Remarks

This paper shows that Azerbaijan's ICTs sector is not comparable to the successful and potential benchmark countries in the Balkans (e.g., Slovenia, Greece, and Romania). The HCA for the period between 2012 and 2020, as well as the HCA for 2020, found that Albania, North Macedonia, and Bosnia and Herzegovina are more similar to Azerbaijan when ICTs are measured using variables such as fixed telephone subscriptions (per 100 people), fixed broadband subscriptions (per 100 people), mobile subscriptions (per 100 people), Internet users (in % of population), and 4G network coverage (in %). This prompts us to reconsider ICTs in Azerbaijan because, although the country has a larger market and almost the same economic opportunities, it lags somewhat in technology adoption.

Compared to the Balkan countries, Azerbaijan lags behind in terms of fast and affordable import of ICTs products from benchmark countries (e.g., Germany, France). Furthermore, the devaluation of the Azerbaijani manat in 2015 resulted in increased import costs. While private companies may have faced some constraints during this period, they were expected to adapt to the new economic conditions. Interestingly, the Slovenian and Greek telecommunications sectors show a more differentiated picture in terms of competition in their own markets and greater openness to multinational companies. Azerbaijan, on the other hand, suffers from monopoly or cartel-like market structures. This undoubtedly leads to numerous suboptimal resource allocations and inefficiencies. Additionally, the Azerbaijani government faces institutional challenges and transparency issues regarding official tenders, logistics, and government procurement contracts. Overall, it is surprising to observe similarities in the ICTs sector between oil-rich Azerbaijan and less developed (in the sense of economic development) countries in the Balkan region.

There are several limitations to this study that should be kept in mind before drawing definitive conclusions. First, it should be noted that these are general observations that would require more extensive analysis and research to understand the specific factors contributing to the similarities in ICTs development among these countries. The changes in technological structures and ICTs use are far from fully analyzed, even for advanced economies around the globe, let alone developing countries such as the Balkans or Azerbaijan. Meeting the challenges and promoting ICTs research will require concerted action by academic institutions, policymakers, and funding organizations to create the necessary support, infrastructure, and incentives for researchers in this field.

Second, HCA requires a large sample size and a large number of case countries to provide meaningful and generalizable results. Although in this study the sample size met some minimum requirements and methodological considerations, the sample size was small, and the number of countries was also limited. The HCA was intended to be highly tailored to address specific research questions and objectives in order to answer general questions and contribute to the literature. Nevertheless, this study offers a new perspective on two relatively similar regions: the Balkans and the South Caucasus (using Azerbaijan as an example).

Third, government policies and private sector involvement in ICTs and other technology-related issues are key to understanding past and current dynamics. This topic has not been specifically

addressed in this paper. It would be a good candidate for analysis by political economists in future studies.

The following policy implications can be drawn from the findings of this research: Investments in broadband networks and end-to-end Internet access, especially in rural and remote areas, could significantly boost ICTs capacity among Balkan nations and Azerbaijan. This will enable digital transformation and ICTs adoption. Improving digital literacy and training workers in the use of ICTs solutions, ICTs in schools, colleges, and universities will increase digital literacy rates. Promoting entrepreneurship and ICTs solutions through incentives, funding, and mentoring will also create a more innovative ICTs environment. To do so, developing ICTs in government, the private sector, and academia and promoting public-private infrastructure, research, and knowledge sharing can be considered as key to a sustainable ICTs sector among the analysed countries. Using International cooperation and partnerships to learn from advanced nations can be a good starting point for joining regional ICTs development projects and seeking International support too.

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